

CLAIMS

1. Pump device for the hydraulic actuation of a valve, in particular for a valve used in the production of crude oil or natural gas, such as a safety valve assigned to a pipeline or a tree, the pump device comprising:

a piston-cylinder unit from which hydraulic fluid can be pumped in the direction of the valve under pressure; and an electrical drive device movably connected to the piston of the piston-cylinder unit for the alternating movement of the piston in a piston longitudinal direction inside the cylinder.

2. Pump device according to claim 1, wherein the electrical drive device includes a spindle drive, a reduction gear, a spur gear and at least one drive shaft with at least one electric motor rotating the drive shaft.

3. Pump device according to claim 1, wherein the spindle drive includes a rotatable, but axially immovable spindle nut and an axially movable threaded spindle.

4. Pump device according to claim 1, wherein the threaded spindle is releasably connected at its actuating end to the piston.

5. Pump device according to claim 1, wherein the spindle nut is movably connected to the reduction gear.

6. Pump device according to claim 39, wherein the spindle nut is rotationally rigidly connected to a flexible, cup-shaped toothed sleeve of the harmonic drive gear.

7. Pump device according to claim 6, wherein a rotating sleeve, which is rotationally rigidly connected at one end to the toothed sleeve and at its other end to the spindle nut, is arranged between the toothed sleeve and the spindle nut.

8. Pump device according to claim 39, wherein a wave generator of the harmonic drive gear is rotationally rigidly connected to a first spur wheel of a helically toothed spur gear and a second spur wheel is rotationally rigidly arranged on the drive shaft driven by the motor.

9. Pump device according to claim 8, wherein the spur gear is a double helical gear.

10. Pump device according to claim 1, wherein the piston is adjustably supported in a piston chamber of the cylinder in the piston longitudinal direction, whereby the piston chamber exhibits on its face side at least one suction and one discharge hole.
11. Pump device according to claim 10, wherein each hole is assigned a non-return valve, which is subjected to a force opposite to the hydraulic fluid flow direction through the respective hole.
12. Pump device according to claim 1, wherein the holes are formed in a cylinder bottom plate releasably fixed on the cylinder.
13. Pump device according to claim 10, wherein the suction hole opens into an intermediate reservoir of the pump device with its end facing away from the piston.
14. Pump device according to claim 13, wherein a feed pipe for the hydraulic fluid opens into the intermediate reservoir.
15. Pump device according to claim 10, wherein the discharge hole is connected to a discharge pipe for the passage of the hydraulic fluid in the direction of the valve.
16. Pump device according to claim 10, wherein the discharge pipe is brought out through the intermediate reservoir from a pump housing.
17. Pump device according to claim 16, wherein a connecting pipe branches from the discharge pipe for the connection of an accumulator.
18. Pump device according to claim 17, wherein the accumulator exhibits a pressure vessel in particular in the form of Belleville springs.
19. Pump device according to claim 17, wherein at least one branch pipe branches from the discharge pipe and / or the discharge hole.
20. Pump device according to claim 19, wherein a first branch pipe leads to a pressure switch.

21. Pump device according to claim 20, wherein on reaching a predetermined hydraulic fluid pressure in the first branch pipe, the pressure switch outputs an electrical control signal for opening a safety valve.
22. Pump device according to claim 21, wherein the safety valve is arranged in a second branch pipe.
23. Pump device according to claim 21, wherein the safety valve is formed as a mechanically actuatable non-return valve.
24. Pump device according to claim 21, wherein the electrical control signal can be transferred to an electric servomotor through which the safety valve can be mechanically actuated.
25. Pump device according to claim 24, wherein a pinion is drive-connected to the servomotor, the pinion being rotationally connected to a cam disc, whereby an actuating plunger of the safety valve is in contact with the cam disc.
26. Pump device according to claim 25, wherein the cam disc includes at least an actuating cam along its circumference.
27. Pump device according to claim 25, wherein the actuating plunger is a roller plunger, which with its roller is in rolling contact with a circumferential surface of the cam disc.
28. Pump device according to claim 27, wherein the roller plunger is subject to spring pressure in the direction of the cam disc.
29. Pump device according to claim 25, wherein the cam disc and / or the servomotor is assigned an automatic reverse rotation device for the reverse rotation of the cam disc.
30. Pump device according to claim 29, wherein a wound or spiral spring is assigned to the servomotor as a reverse rotation device, which can be transferred by actuation of the servomotor for opening the safety valve from an essentially destressed state into a stressed state.
31. Pump device according to claim 30, wherein the wound / spiral spring is drive connected on the rear side of the servomotor facing away from the pinion to the servomotor.

32. Pump device according to claim 13, wherein a feedback pipe for the feedback of the hydraulic fluid when the safety valve is open runs from the safety valve to the intermediate reservoir.
33. Pump device according to claim 1, wherein the pump device is of modular construction.
34. Pump device according to claim 25, wherein the cam disc is rotationally supported on an external circumference of the rotating sleeve.
35. Pump device according to claim 1, wherein a quick-release coupling device is arranged between the pump housing and a hydraulic fluid supply pipe.
36. Pump device according to claim 1, wherein at least two servomotors are arranged redundantly with respect to one another.
37. Pump device according to claim 1, wherein the hydraulic fluid is an injection fluid.
38. Pump device according to claim 3, wherein a position sensor is assigned to at least the threaded spindle.
39. Pump device according to claim 5, wherein the reduction gear is a harmonic drive gear.
40. Pump device according to claim 24, wherein the electric servomotor is a stepper motor.
41. Pump device according to claim 30, wherein the wound or spiral spring is a clockwork spring.
42. Pump device according to claim 37, wherein the injection fluid is an inhibitor.
43. Pump device for the hydraulic actuation of a safety valve on a pipeline or tree used in the production of hydrocarbons, the pump device comprising:
 - a body with a cylinder housing a piston such that hydraulic fluid can be pumped under pressure in the cylinder in the direction of the safety valve; and

an electrical drive device movably connected to the piston of the piston to move the piston in a longitudinal direction inside the cylinder upon the hydrocarbons reaching a predetermined pressure.